DOCUMENT RESUME

ED 166 650 CS 004 608

AUTHOR Hughes, Rowland
TITLE Helping Parents Read Mathematics with Children.
PUB DATE Feb 78
NOTE 15p.; Paper presented at the Annual Meeting of the Parents and Reading Conference (3rd, New York City, February 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Elementary Education; *Mathematical Vocabulary; *Mathematics Instruction; *Parent Role; *Reading Difficulty; *Reading Instruction; *Teaching Techniques

ABSTRACT

Some difficulties children have with mathematics are related to reading problems and not to mathematics itself. The ability to read mathematics is related to reading but is a specialty within that ability and can be taught by the teacher and by parents. Both specialized vocabulary and sentence structure must be learned by the student. For the teacher, the process includes analyzing the most important concepts, listing the words or other symbols essential to each concept, and setting priorities. Children must begin by learning to perceive symbols. Then they must attach a literal meaning to the symbol, analyze relationships, and solve word problems. One recommended procedure for helping children learn to read word problems is to have them first read to visualize the situation, reread to get the facts, note problem vocabulary or concepts, reread in planning the steps for solution, and read the problem again to check the procedure and solution. Parents can begin early to help their children read mathematics by reading them stories and poems related to numbers and mathematics. (TJ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED166650

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

HELPING PARENTS READ MATHEMATICS WITH CHILDREN

Rowland Hughes
Fordham University, New York City

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Rowland Hughes
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

Family friend: How are you doing in arithmetic?

Third grader: All right, I guess, but I don't read too well, so if there are lots of numbers I add, and if there are only two numbers with lots of parts I subtract. But if there are just two numbers and one littler than the other, it's hard. So I divide--if they come out even, but if they don't I multiply.

If a child is not successful in arithmetic, many parents and teachers mistakenly assume the entire problem to be a "natural" dislike for the subject. The child's lack of success may be characterized by incomplete homework, inaccurate work, unwillingness to explore by himself the field of mathematics beyond those assignments made by the teacher in the standard text, inattentiveness, and a verbally pronounced discontent with the subject. Admittedly, each of these symptoms could be associated with a dislike of mathematics, but each of them could also be attributed to reading problems associated with mathematics and not to mathematics *per se*.

Many teachers take the attitude that all reading should be taught by the language-arts teacher and that only mathematics should be taught by the mathematics teacher. Further, they argue that if the child does not know how to read, it is not the responsibility of the mathematics

CS004608

teacher to teach him the reading fundamentals. Unfortunately, this attitude is based on the unwarranted assumption that the reading skills encountered in literature are identical with those in mathematics and that no specialized work on the reading of mathematics is required.

Recent investigations concerning children's homework and reading have produced optimistic results. Maertens and Johnston (1972) determined that the reading of homework combined with the rarely investigated variable of parental involvement has a significant effect upon computation and problem-solving performances. Keeves (1975) found that attitudes of parents toward mathematics does make a significant difference in pupil achievement.

Perhaps the attitudes of some educators have not helped us to realize the potential of the parent in helping the child to read mathematics. Listen to one administrator's recently expressed opinion:

> What can parents do to help? How should this kind of math teaching (individual instruction) be reinforced at home? First of all, we shouldn't help our child with his math homework even if we understand it. This gives the teacher false information about him so that he can't be helped at school.

How can we begin to help the parent understand the child's difficulties in reading and learning mathematics? Somehow, in some organized, informative way--in workshops, lectures, meetings--classroom teachers, mathematics

curriculum specialists and coordinators must make parents aware of some general characteristics of mathematics about which most of them have probably thought very little.

Curriculum specialists for the Florida State Department of Education (1976) have clearly described mathematics as a single abstract science which

> . . . involves the use of a highly abstract symbolic system with specialized symbolism and technical terminology. Thus, the language of mathematics differs significantly from ordinary English. While many of the word attack skills learned in ordinary reading programs are applicable to the language of mathematics, more specialized skills are required to read mathematics. Effective reading of ordinary English prose does not imply equivalent effectiveness in reading mathematics. . . . Most mathematics educators and reading specialists agree that the development of skills in reading and communication in mathematics cannot be divorced from the development of skills and concepts in the content. (p. iii)

No student, at any level, ever comes to a mathematics class knowing how to read <u>all</u> the content of the course. Moreover, the reading teacher never has had the opportunity to teach students to read, interpret, translate, and comprehend specialized symbols such as $3 + 2 =$, $f(x) = 3x + 1$, or $A = \pi r^2$.

Obviously meaningful interpretations of such mathematical symbols require considerable content knowledge on the student's part. Parents must realize what a capable teacher of mathematics already knows: Many seemingly familiar words take on precise technical meanings when used in mathematics.

Consider just a few examples: point, addition, proper (a proper subset), regular, square, ray, group. Therefore it is the major responsibility of the mathematics teacher for teaching students to read mathematics. This is not implying that mathematics teachers must teach general reading skills. This responsibility clearly lies with the reading teacher.

As with general reading, there are no "cure-all" techniques which will allow the mathematics teacher to teach all children to read the language of mathematics. The battle is often half won if mathematics teachers, reading teachers, and parents agree that a problem does in fact exist and are aware of some of the factors which make the language of mathematics difficult to read.

Several factors related to the student, such as his interest and motivational level, his readiness for reading mathematics, his reading level in ordinary English, and his understanding of the purpose for reading mathematics contribute to the problem. Moreover, Willmon (1971) has pointed out that while the reading ability of many pupils is below grade level, the reading level of most elementary mathematics textbooks is decidedly above grade level.

Parents should know that for many students the structure of the language of mathematics makes it difficult to read. Look at these differences between the two languages:

(1) Ordinary English uses a standard set of 26 symbols. Mathematics uses these symbols plus many non-alphabetic, mathematical symbols, such as $\sqrt[3]{8}$, 60°, $l_1 \perp l_2$.
(2) The sentence structure in mathematics is different from that of English. Read aloud slowly "$1 < 2 < 3$."
(3) In mathematics one does not always read from left to right and down the printed page, as when we read "$\frac{3}{5} = \frac{n}{15}$."
(4) The language of mathematics is not a commonly spoken language as you will notice when you read aloud "$34_{five} = 19_{ten}$" and realize that there is little likelihood that such a mathematical sequence will arise naturally outside the classroom.

What should the parent know about the actual process of learning mathematics? The content of mathematics determines the process necessary for mastery. In other words, the concepts that make up a reading task in mathematics can reveal to the teacher which reading skills are necessary in order to grasp the concept successfully or to arrive at the correct solution. The teacher's task actually begins with an analysis of the content of a reading task to determine exactly what concepts are present in the material. How can this be done? First, the teacher identifies the next mathematical topic and selects a short section or unit. Then, as Earle (1976) has noted, the teacher follows these three steps as he/she prepares for teaching:

1. Identify the most important concepts. These are content objectives, for which the teacher produces statements of student understanding rather than mere topic or teacher behaviors. Look at the statement "The perimeter of a polygon is the sum of the lengths of its sides." Notice how this statement differs from this statement of topic "Finding perimeter" or this statement of teacher behavior: "To define the term perimeter."

2. List the words or other symbols essential to each concept. The perceptive mathematics teacher will avoid the temptation to select only "hard" words or symbols, such as hypotenuse, π, or associative. Friedland and Gross (1977) have formulated a useful worktext, in which words which are part of the mathematics vocabulary have been clustered into a series of units each concerned with one key concept, such as Question Words, Multiplication Words, Fraction Words, and Direction Words.

3. Set priorities. Often a well-intentioned teacher, especially at first, is likely to include many more content objectives than can possibly be mastered. Parents should realize that the teacher continually faces the painful process of reducing the number of objectives to manageable proportions and that the teacher simply can't cover everything. The list of content objectives must be held to a reasonable number if teachers or pupils are to be held

accountable for them.

Earle (1976) has further provided a viable classroom model or sequential outline for mathematical reading, noting that

> any content objective in mathematics can be mastered by psycholinguistic activity at one or more of the following levels of reading: (1) Perceiving Symbols; (2) Attaching Literal Meaning; (3) Analyzing Relationships; and (4) Solving Word Problems. As a general rule, these activities occur in a hierarchy, that is a reader must be successful at one level of reading before he can hope to achieve success at the next level. (p. 5)

Perceiving Symbols. This first level of reading in mathematics involves the recognition and pronunciation of any words or other symbols essential to a particular objective. The child does not comprehend at this level; he simply recognizes a printed symbol as more or less familiar and pronounces it aloud to himself. This is where comprehension really begins. If a child is unable to pronounce $\sqrt{9}$ as "the square root of nine," he will have an inordinate amount of difficulty in mastering more comprehensive symbolic tasks, such as $(\sqrt{9})^2$ or $9^{\frac{1}{2}}$. At this level the parent can certainly help the children in exposing repeatedly to sight and sound those symbols deemed necessary in the content analysis referred to earlier. A proud father told me that after repeatedly using the word length in simple problems he had made up, asking his son what this word meant, and letting Sam struggle

to tell him, the child gradually began to understand and use the word. Of course, Sam's teacher has stressed the use of paper and pencil exercises, overhead projector, flash cards, labeling and chalkboard to extend his understanding of this single concept. The concerned parent will want to make a consistent effort at home to reinforce simple concepts taught in the classroom.

Attaching Literal Meaning. Inaccurate or hazy definitions of essential mathematical terms make successful reading or learning difficult or impossible. Most parents are interested to learn of three commonly recognized types of vocabulary: general, technical, and special. Technical terms in mathematics include such words or symbols as polygon, ≠, or multiplicand. Parents must recognize that the most difficult task for the child is posed by special vocabulary, symbols which have one meaning in everyday use but take on specialized meanings in the context of mathematics--words such as closed, base, property, point. Parents can help children learn to define such terms by, for example, talking about and listing the characteristics of a triangle; showing the child simulated examples of a triangle cut from paper or pointing out triangles in drawings and pictures; or in industrial, architectural, or decorative features of real life. A parent should encourage the use of a children's dictionary or the glossary of mathematical terms

found in many elementary textbooks. One mother I know forms sentences with words for contextual analysis by her eight-year old. She is using the process of clarifying meaning by examining the context in which a word appears. For example, This problem is simple. Simple Simon was not very smart. He made a simple curve in the sand with his stick.

Analyzing Relationships. Parents must perceive that success at this level requires children to identify clearly critical relationships among words or ideas. The child must identify the topic the words describe, add other essential symbols, and eventually discard irrelevant ones. Some teachers use the technique of structured overview or diagraming the interrelationships among key words or concepts particular to a mathematical learning task. They may ask pupils to explore relationships among terms, for example, angle, acute angle, right angle and obtuse angle. Which of these terms represents an idea which includes all others? The child must master what Jean Piaget calls class inclusion--the logical operation of simple classification. For example, in mathematics the whole numbers include the odd numbers. Parents can help to strengthen a child's grasp of important conceptual relationships among the vocabulary essential to a given unit of study. Using words orally at home to point out to the child that winter

includes ice, cold, and snow can reinforce to the child that one idea or term includes all the others.

Solving Word Problems. The solution of word problems is one of the most sophisticated of all tasks in mathematics. Hater, Kane, and Byrne (1974) have aptly observed that reading and interpreting verbal problems in mathematics has often been equated with the larger problem of reading ordinary English. It is clearly necessary that students be able to read in order to solve problems, but it is not sufficient. The situation is far more complex than that. Reading is part of the difficulty, and teachers can help students develop the ability to solve verbal problems by involving them in lessons that include some of the factors necessary to successful reading and interpretation of problems. Such activities include discovering the question, identifying relevant information, translating the information from verbal to symbolic form, using concrete situations to act out problems, recognizing concepts and operations from word forms, and constructing an appropriate mathematical model (usually a number sentence, sometimes a diagram).

Parents should recognize that with the least variation in problem wording, a child becomes hopelessly confused. There is no one simple way to solve word problems. Instead, students must be guided in the approximate sequence through

a variety of problem situations.

Spencer and Russell (1960) have suggested that the child seldom reads in arithmetic for just one purpose. Here his purposes are frequently many: to grasp the total idea, to note sequence, to relate two significant ideas, and to find the key question--to name a few.

If a parent is knowledgeable and interested enough to help the child read word problems, he should be informed that the following steps are widely prescribed (Earp, 1970) in the literatur[illegible]problem solving:

1. Use a fi[illegible] reading to visualize the situation, to get a general grasp of it. The child need not pay much attention to the actual numerals during this reading. He may, in fact, be asked to read orally and leave the numerals out of this reading. For example, he can say, "Tom has some stamps . . ." rather than "Tom has 123 stamps. . . ."

2. Reread to get the facts, paying particular attention to the information given and the key question which is the basis for programming the problem.

3. Note problem vocabulary or concepts and explore these with the help of the parent.

4. Reread as a help in planning the steps for solution. On this reading some arithmetic authorities have the child state the situation in a mathematical sentence. A parent can encourage the child to give a sensible estimate of the

answer prior to actual processing of the problem. Screening out irrelevant data or noting the need to seek out additional data may be involved in this very careful reading. (Problems containing irrelevant data and also those in which the child must seek elsewhere for relevant data should be included in the arithmetic program.)

5. Read the problem again to check your procedure and solution, to note if all work has been done. The child must be taught to do this even after the processing is complete.

Thus several readings are entailed in properly approaching problem solving in arithmetic, and the parent can motivate the child at home to reread problems both orally and silently for greater understanding. Various other helpful techniques may be used, such as having the child state a problem in his own words, after two or three readings, to check his understanding of concepts and vocabulary.

The helpful parent is aware that the teacher is probably using the above or similar steps in helping the child to analyze word problems, and that it is the classroom teacher who takes the effective action in making children better readers of mathematical content.

Even if a parent does not feel knowledgeable enough to help children read word problems involving details or simple computations, he or she can use children's literature

as a means of motivating the children in the mathematics class. By periodically reading with the child stories and poems (The Three Bears, David Smith's Number Stories of Long Ago, "One, Two, Button My Shoe . . ."") related to numbers and mathematics, the "parentcator" can help to clarify ideas, illustrate practical applications of mathematical ideas, stimulate creative expression, and develop vocabulary skills.

Rich and Jones (1978) have focused clearly on parent-child involvement in presenting numerous practical Take Home Learning Recipes in the three R's for greater pupil comprehension. One suggested parental activity for helping the child to understand the meaning of such Famous Fractions as halves, thirds, and fourths involves the child's folding such items as napkins, towels, and bedding into these parts, and cutting sandwiches or fruits into halves or fourths. Can Tom or Linda cut a sandwich into thirds?

Five Years Old

Please, everybody, look at me!
Today I'm five years old, you see!
And after this, I won't be four!
Not ever, ever any more!
I won't be three or two or one
For that was when I first begun.
Now I'll be five awhile and then
I'll soon be something else again.

REFERENCES

Byrne, Mary Ann, Mary Ann Hater, and Robert B. Kane. Helping Children Read Mathematics. New York: American Book Co., 1974.

Earle, Richard A. Teaching Reading and Mathematics. Newark, Del.: International Reading Association, 1976.

Earp, N. Wesley. "Procedures for Teaching Reading in Mathematics," Arithmetic Teacher, 17:575-579, November, 1970.

Florida State Department of Education. Reading the Language of Mathematics. Tallahasee, Fla.: Division of Public Schools, 1976.

Friedland, Joyce, and Irene Gross. Reading for Mathematics: A Worktext to Improve Reading Skills in the Content Area of Mathematics. Phoenix, N.Y.: Frank E. Richards Publishing Co., 1977.

Hater, Mary Ann, Robert B. Kane, and Mary Ann Byrne. "Building Reading Skills in the Mathematics Class," Arithmetic Teacher, 21:662-668, December, 1974.

Keeves, J. P. "The Home, the School, and Achievement in Mathematics and Science," Science Education, 59:439-460, October-December, 1975.

Maertens, Robert, and James Johnston. "Effects of Arithmetic Homework upon the Attitudes and Achievement of Fourth, Fifth, and Sixth Grade Pupils," School Science and Mathematics, 72:117-126, February, 1972.

Rich, Dorothy, and Cynthia Jones. The Three R's Plus: Teaming Families and Schools for Student Achievement. Washington, D.C.: Home and School Institute, 1978.

Spencer, Peter L., and David H. Russell. "Reading in Arithmetic." In Instruction in Arithmetic. Twenty-Fifth Yearbook of the National Council of Teachers of Mathematics. Washington, D.C.: The Council, 1960.

Willmon, Betty. "Reading in the Content Area: A 'New Math.' Terminology List for the Primary Grades," Elementary English, 48:463-471, May, 1971.